# BULLETIN

OF THE

# Society

FOR THE

# Promotion of Engineering Education

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Volume II

PUBLICATION COMMITTEE

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# BULLETIN

OF THE

# Society for the Promotion of Engineering Education

Vol. II LANCASTER, PA., SEPTEMBER, 1911 No. 1


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## EDITORIAL.

*The Convention.*—While the Pittsburgh meeting was not as large as its predecessor it was enjoyable and profitable. The papers were well prepared and sufficiently numerous and diversified. Several new experiments were described, indicating that technical education has not yet settled into ruts. Committee reports of moment were presented, discussed and accepted and will be promptly published so that they may become immediately effective. Good-fellowship prevailed during the sessions as well as at the numerous social functions which added so much to the success of the meeting. The minutes of the meeting are printed in this issue for the information of the members who were not able to be present at the meeting and to refresh the memories of those who were.

*The Bulletin.*—The members present at the Pittsburgh

meeting voted unanimously to continue the publication of the BULLETIN, as it seems to meet a real need in the work of the Society. To make this possible required the raising of the dues to $4.00 and this was unanimously but reluctantly decided upon. In view of the satisfactory condition of the finances at the end of the year members who did not hear the discussion at Pittsburgh may wonder why an increase in the dues is necessary. As was there pointed out the Society is now reaching such a size that it will soon be necessary to reorganize the work of the secretary's and the treasurer's offices on a salary basis, possibly combining the two positions. This will be more expensive especially with the added burden of the BULLETIN. With a membership fee of $4.00 and with a reasonable increase in membership it is expected that the Society will be in a position to take this step in a few years.

In order that the BULLETIN shall meet the needs of the Society it will be necessary for each member to feel his individual responsibility in connection with it. The BULLETIN should become more and more the natural vehicle for papers regarding matters affecting technical education. Papers too short for presentation at the meeting, or treating of topics of less than prime importance will be welcome. Papers intended for the annual meeting will, if received in time, be printed in the BULLETIN in advance of the meeting. College and personal news should form an important part of the contents. The opening of the college season should be productive of many and interesting contributions.

## NEW MEMBERS.

At the annual meeting of the Society held at Pittsburgh the applicants listed in the June BULLETIN, as well as the following, were elected, making a total of forty-two.

ALEXANDER, M. W., Engineer with the General Electric Co., Lynn, Mass. ..... 1911

DAVIS, C. H., President of various corporations, South Yarmouth, Mass. ..... 1911

HARPER, A. C., Instructor in Engineering Drawing, Columbia University, New York, N. Y. ..... 1911

HAULTAIN, H. E. T., Professor of Mining Engineering, University of Toronto, Toronto, Ontario ..... 1911
MCALISTER, E. H., Dean of the College of Engineering, University of Oregon, Eugene, Oregon ..... 1911
MCCAFFERY, R. S., Professor of Mining and Metallurgy, University of Idaho, Moscow, Idaho ..... 1911
MCCRUM, BEN, Draftsman with the McClintic-Marshall Construction Co., Pittsburgh, Pa. ..... 1911
MCMEAN, S. C., Consulting Engineer, 1454 Monadnock Block, Chicago, Ill. ..... 1911
SWINNEY, J. B., Educational Dept., Longmans, Green and Co., New York City ..... 1911
WAGNER, F. C., Professor of Mechanical and Electrical Engineering, Rose Polytechnic Institute, Terre Haute, Ind. ..... 1911
WAGNER, S. T., Assistant Engineer, The Philadelphia and Reading Railway Co., Philadelphia, Pa. ..... 1911
WATTS, C. W., Professor of Mathematics, The Virginia Military Institute, Lexington, Va. ..... 1911

## APPLICANTS FOR ADMISSION.

HERSCHEL, W. H., Inspector, Isthmian Canal Commission, 137 W. Swissvale Ave., Edgewood, Pa. ..... 1911
PEGRAM, G. H., Chief Engineer, The Interborough Rapid Transit Co., 165 Broadway, New York, N. Y. ..... 1911
THOMAS, G. B., Professor of Electrical Engineering, Colorado College, Colorado Springs, Colo. ..... 1911
WRAY, J. G., Chief Engineer, The Chicago Telephone Co., 230 W. Washington St., Chicago, Ill. ..... 1911

## CHANGES IN ADDRESS.

At this season of the year many members of the Society are taking up work in new positions. The Secretary will be pleased to be informed of changes promptly.

Professor L. D. Huntoon has changed his address from Yale University to 42 Broadway, New York, N. Y.

Mr. Chas. McGonigle's address is, care of Milliken Bros. (Inc.), Chamber of Commerce Bldg., Portland, Oregon.

Professor J. D. Newton, A.M., M.E. (Cornell '95), formerly of the University of Kansas, has been elected Dean of the College of Engineering of Loyola University, Chicago, Ill.

Professor Harris J. Ryan, of Leland Stanford University, is on leave of absence this year. His address is La Jolla, California.

The address of Mr. M. W. Pullen is now Onawa, Iowa.

Mr. E. E. King, who spent last year in graduate study at Cornell University is now at the Iowa State College, Ames, Iowa.

Professor A. M. Buck, formerly head of the electrical department of the Clarkson School of Technology, has joined the faculty of the Electric Railway Department of the University of Illinois.

# PROCEEDINGS.

## PITTSBURGH MEETING.

## JUNE 27 TO JUNE 29, 1911.

The nineteenth annual meeting of the Society for the Promotion of Engineering Education was held at the Carnegie Technical Schools and the University of Pittsburgh, Pittsburgh, Pa., on Tuesday, Wednesday and Thursday, June 27, 28 and 29, 1911. The meetings were held in the buildings of the Schools of Applied Science and Applied Industries of the Carnegie Technical Schools and in Thaw Hall of the University of Pittsburgh.

## TUESDAY, JUNE 27.

### *Morning Session.*

The meeting was called to order at 10:00 a. m. by President Arthur N. Talbot, Professor of Municipal and Sanitary Engineering, University of Illinois. The meeting was opened by an address of welcome from Director Arthur A. Hamerschlag, of the Carnegie Technical Schools. This address was responded to by President Talbot.

The first paper of the meeting, "Teaching English in Technical Schools," by Professor S. C. Earle, Tufts College, was presented by Dean G. C. Anthony of Tufts College. Following this Professor F. N. Raymond, of the University of Kansas, abstracted his paper on "The Preparation of Written Papers in Engineering Schools." The two papers, being in a similar field, were discussed together. The discussion showed great

interest in the subject. The President, Mr. Kent, Mr. Gehring, Professors Jacoby, Telleen, Hibbard, Flather, Tracy, Young, Magruder and Raymond, and Dean Anthony took part in the discussion.

Professor H. Wade Hibbard abstracted a paper by Professor H. S. Philbrick and himself, entitled "The Teaching of Scientific Shop Management, with the Use of Engineering School Shops as the Laboratory." They opened up a new field for study by the Society. An animated discussion by Professors Kunze, Hibbard, Wood, Mr. Kent and Director Williston followed the reading of the paper. Professor A. H. Blanchard then read his paper on "Graduate Courses in Highway Engineering at Columbia University."

At the close of the morning session a representative of the Conventions Bureau of St. Louis presented an invitation from that body for the Society to meet in St. Louis in 1912. The invitation was informally referred to the incoming Council for attention. Mimeographed copies of the reports of the Treasurer and the Secretary were distributed so that they might be studied in advance of their formal presentation.

*Afternoon Session.*

The larger portion of the afternoon session was taken up with a consideration of the report of the Committee on the Teaching of Mathematics to Engineering Students. This report had been printed in full in the BULLETIN during the year so that the members of the Society had had ample time to study it. After long discussion the following motions were passed: (1) That the Society accept the report and that the syllabi be printed in the Proceedings of the Society after the Committee has made such additions and modifications as they desire in view of the discussion at the meeting; and (2) that the Committee be requested to bring in a report covering the subjects of dynamics and numerical calculations at the next meeting. The hope was expressed that this report might appear in the BULLETIN in advance of the 1912 meeting.

Dean C. H. Benjamin's paper "The Balance of Courses in Chemical Engineering" was read in full by the Secretary and discussed by the President, Dean Bishop, and Professors Wood, Morse and Miller. A paper by Professor J. H. James, of the Carnegie Technical Schools, entitled "Chemical Education for the Industries" was then read by title.

*Evening Session.*

In the evening after the dinner at the Country Club, tendered to the Society by Director A. A. Hamerschlag on behalf of the Carnegie Technical Schools, President Talbot delivered his presidential address on the subject "The Engineering Teacher and his Preparation."

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WEDNESDAY, JUNE 28.

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*Morning Session.*

In accordance with the instructions of the Council the Secretary announced that at the evening session the question of raising the dues to $4.00 per year would come up for discussion and settlement. After a thorough study of the matter during the year the Program Committee had recommended that it is advisable to continue the publication of the BULLETIN and that it seems practicable to do so by an increase in the dues.

Chairman J. J. Flather, of the Committee on Entrance Requirements, presented an abstract of the report of the Committee, which had appeared in the BULLETIN. He stated that the report is essentially the same as that presented at the Madison meeting with the exception of the requirements in mathematics. He stated farther that the members of the Committee wished the report to be considered a final one and that they desired to be discharged. After a very full discussion of the report the following motion was passed: That the

report of the Committee be accepted with the thanks of the Society and that the Committee be discharged. It was the sense of the meeting that the Committee has the right to make slight modifications in the report before it is printed in the *Proceedings* if they so desire. As the Committee on Entrance Requirements is a standing one, President Talbot called attention to the fact that the incoming administration would appoint a new committee.

At this point in the session President Talbot announced as the Committee on Resolutions, Professors J. C. Tracy, H. S. Jacoby and E. C. Schmidt; and as the Auditing Committee, Professors A. J. Wood, J. E. Boyd and J. P. Spalding. He also called attention to the fact that the Nominating Committee consists of the past-presidents of the Society and of those members of the Council whose terms of office expire at the next meeting.

After the above announcements, Mr. H. A. Gehring, of the staff of the New York State Engineer, read a paper on "The Use of Logarithmic Diagrams in Laboratory Work." The members present agreed with the speaker as to the importance of checking results as laboratory work proceeds. Professor J. M. White, of the University of Illinois then read his paper on "The Architecture of Engineering Schools."

After the morning session an opportunity was afforded for the members to make a brief inspection of the buildings of the Carnegie Technical Schools.

### *Evening Session.*

The evening session was held in the main lecture room of the School of Applied Industries of the Carnegie Technical Schools. An executive session was first on the program. The Council made a number of recommendations which were acted upon as follows:

1. That a list of forty-two applicants, approved at the morning meeting of the Council, be elected. The Secretary was instructed to cast a unanimous favorable ballot for the Society, which he did.

2. That the dues of the Society be increased to four dollars per year, this recommendation having been made by the Program Committee and approved by the Council by letter ballot more than thirty days in advance of the meeting. The recommendation was unanimously approved by the Society.

3. That the BULLETIN be continued and established as a permanent institution. This was unanimously adopted.

4. That the By-laws be amended as follows: Add to line 4, article 6 "except the volume of the *Proceedings* of the last convention, which shall be edited by the retiring Secretary." After explanation by the President that the purpose of the by-laws is to make it the duty of the retiring Secretary to edit the proceedings of the meeting which he had organized and with which he, therefore, was most familiar, the amendment was unanimously adopted.

5. That, in view of the difficulty of doing justice to the enormous number of technical books, it is deemed inexpedient to publish the report of the Committee on Technical Books for Libraries. This recommendation was adopted after explanation that the recommendation of the Council was made after the presentation of a report to the same effect from the Program Committee which had given careful study to the matter during the year.

The reports of the Treasurer and the Secretary were next presented.* As these had been distributed in mimeograph form they were not read. The reports were accepted by the Society with a vote of thanks for the efforts of all of the officers to make the work of the Society a success during the past year. The Auditing Committee, consisting of Professors A. J. Wood, J. P. Spalding and J. E. Boyd, then reported that they had examined the Treasurer's records and vouchers and that these had been found to be correct.

Mr. Kent suggested that as the finances of the Society seem to warrant it, in the future all papers should be printed in advance of the meeting so that the members can have an

* These reports will appear in the October BULLETIN.

opportunity to study them carefully. In this case it would not be necessary to consume more than, say, five minutes in the presentation of an abstract at the meeting. Professor Jacoby endorsed this suggestion and stated that the members should be able to expect the Program Committee to set a date on which the manuscripts of papers shall be in hand, giving the right of way at the meetings to papers which have been printed in advance. Provision should be made for papers which come in late but it should be understood that these will have only such consideration as can be given them after the other papers have been considered.

Professor Magruder raised a question as to the proper time of the year at which the meetings of the Society should be held. A number of members spoke informally, "pro and con," as to the desirability of holding winter meetings. An informal ballot showed a strong preference among those present for a continuance of the present practice of holding meetings in the early summer.

The Nominating Committee made the following report, signed by Professor C. L. Crandall as chairman:

The Nominating Committee nominates the following members for the respective offices for the ensuing year.

For President: W. G. Raymond, University of Iowa.

For Vice-presidents: G. C. Anthony, Tufts College, and Frank B. Gilbreth, New York City.

For Members of Council: J. E. Boyd, Ohio State University; C. E. Crouch, University of North Dakota; C. E. Magnusson, University of Washington; H. H. Stoek, University of Illinois; J. A. L. Waddell, Kansas City; A. J. Wood, Pennsylvania State College.

For Secretary: H. H. Norris, Cornell University.

For Treasurer: W. O. Wiley, New York City.

After passing a motion that the nominations be closed, the Society instructed the President to cast a ballot for the nominees named by the Committee, which was done.

The balance of the evening session was devoted to the presentation and discussion of two papers, "The Wentworth In-

stitute'' by Director A. L. Williston, and ''The College Campus,'' by Professor J. M. White. The former was illustrated by charts and the latter by lantern slides. A number of interesting features of college campuses and buildings were brought out in the discussion, particularly the relation of the architect to the faculty in the planning and construction of buildings. Another was the location of the library building on the campus with a view to increasing the use of books by making the building accessible. These and other topics were vigorously discussed until a late hour. After the President had invited the newly-elected members of the Council to meet with the 1910–1911 Council the next morning the meeting adjourned.

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## Thursday, June 29.

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### *Morning Session.*

The meeting was called to order at 9:30 by Vice-president Kent, who at the invitation of the President presided at the session. The meeting was held in Thaw Hall of the University of Pittsburgh and Chancellor S. B. McCormick, of the University, welcomed the Society to the University. He explained somewhat of the history of the University and of its relation to the other educational institutions of the vicinity. Vice-president Kent responded to the Chancellor's words of welcome.

Professor S. B. Charters, of the Leland Stanford, Jr., University, abstracted a paper prepared by Professor W. A. Hillebrand and himself on ''An Engineering Course for Underclassmen.'' This was followed by a paper on ''Electrical Engineering Instruction'' prepared and presented by Professor E. B. Paine, of the University of Illinois. Dean W. G. Raymond's paper entitled ''All-year Sessions: Individual Instruction: Renewed Suggestions,'' which had been printed in full on the program, was received by title. These three papers were discussed briefly.

The concluding papers of the session and of the convention were of a similar nature and they were therefore grouped together for presentation and discussion. These were: "Technical Training from the Business Man's Standpoint," by Mr. E. B. Raymond, Vice-president of the Pittsburgh Plate Glass Company; "Adapting Technical Graduates to the Industries," by Messrs. C. F. Scott and C. R. Dooley, of the Westinghouse Electric and Manufacturing Company; and "The Coöperative System of Engineering Education at the University of Pittsburgh," by Dean F. L. Bishop. The Society then proceeded to discuss the qualities of technical students and graduates.

The President then took the chair and called for the report of the Committee on Resolutions. The following report was presented and adopted:

"The visit of the Society to Pittsburgh has been made pleasant to its members by the many courtesies and opportunities for enjoyment offered by those who have so generously assumed the responsibility for this entertainment. The Society appreciates the thoughtfulness and kindness which have been shown in so many ways, and it desires to record this appreciation. Therefore,

"*Be it Resolved,* that the thanks of the Society be hereby tendered to the Administrations and Faculties of the Carnegie Technical Schools and the University of Pittsburgh for providing places of meeting and for their hospitable care and entertainment; to the manufacturing firms of Pittsburgh and the vicinity who have contributed so much of pleasure and profit to the Society by opening their works for inspection; to the local committee to whose efforts and zeal so much of the success of the convention is due; and to all others who in any way have acted as hosts to the members of the Society and to the ladies who have accompanied them."

(Signed) HENRY S. JACOBY,
EDWARD C. SCHMIDT,
J. C. TRACY,
*Committee.*

## Social Features of the Convention.

In planning the program of entertainment, the local committe arranged for every possible opportunity for the members to get together for informal discussion. At noon on Tuesday and Wednesday buffet luncheons were served in the Margaret Carnegie School for Women, conveniently located with respect to the convention building. An ample allowance of time for the luncheon was made and this was utilized by the members in renewing old acquaintances and forming new ones. Following the Tuesday afternoon session the members went by car and automobile to the Country Club where they had the opportunity of meeting the ladies of the faculties of the Carnegie Technical Schools and the University of Pittsburgh, and several of the trustees with their wives. After a social hour in ideal surroundings the members and other guests enjoyed a delightful dinner tendered by Director A. A. Hamerschlag on behalf of the Carnegie Technical Schools. The only after-dinner speeches were a short one by Director Hamerschlag and the presidential address of Professor A. N. Talbot.

On Thursday, following the morning session, the University of Pittsburgh, with Chancellor S. B. McCormick as host, entertained the members at luncheon at the University Club. On Thursday evening an informal reception was held in the foyer of the Carnegie Music Hall. Here an opportunity was afforded for the local alumni of the various colleges to meet their former teachers. Large placards marked the rallying places for a number of the colleges and each man present was tagged with the names of all of the educational institutions with which he had been connected. After the reception a brief program was given on the great organ and a few remarks were made by the famous lens maker, Mr. Brashear, The members then visited the museum and picture gallery of the Institute.

During the sessions the ladies of the convention were entertained by the local ladies with receptions and automobile rides.

### Excursions to Industrial Plants.

As the convention was held in the heart of the industrial district the local committee made the most of the opportunity to show the visitors the manufacturing wonders of the neighborhood. Wednesday and Thursday afternoons were devoted to these excursions and a number of members remained after the convention for additional trips at the invitation of the committee. The value of the inspection trips was enhanced by a handsome hand-book which the local committee prepared and distributed to every member of the Society, whether he expected to attend the meeting or not. This was done without expense to the Society. The book was well illustrated and contained descriptions of all the important manufacturing plants in the vicinity.

For the tireless efforts of the local committee to make the meeting a success the thanks of the Society are due. The committee consisted of Dean J. H. Leete, chairman, Mr. C. F. Scott, Deans C. B. Connelley and F. L. Bishop, and Professor W. E. Mott.

### Attendance at the Convention.

One hundred and nineteen members and guests registered at the meeting, a number considerably smaller than were in attendance last year. This shrinkage may be attributed to the fact that other important conventions were in session at the same time. It had been found impracticable to avoid conflicts but it is hoped that by another year arrangements can be made with other societies by which such conflicts may be minimized.

The names registered are as follows: M. W. Alexander, G. C. Anthony, H. T. R. Aude, E. E. Bankson, Frederic Bass, H. M. Biebel, F. L. Bishop, A. H. Blanchard, J. E. Boyd, J. N. Bradford, A. M. Buck, F. E. Burpee, H. A. Calderwood, T. L. Cannon, R. A. Caughey, S. B. Charters, jr., J. J. Clark, E. F. Coddington, C. B. Connelley, C. L. Crandall, W. R. Crane, C. H. Crouch, H. B. Dates, C. R. Dooley, C. E. Downton, W. H. Dosey, W. W. Dunkin, P. M. Dysart, C. R.

Eastman, F. L. Emory, D. D. Ewing, J. J. Flather, M. M. Foss, T. E. French, A. E. Frost, H. A. Gehring, Edward Godfrey, C. O. Gunther, A. A. Hamerschlag, P. W. Hepburn, H. Wade Hibbard, H. H. Higbie, J. W. Hughes, J. A. Hunter, J. P. Jackson, H. S. Jacoby, Mrs. Jacoby, J. H. James, A. W. Kelly, Morris Knowles, Wm. Kent, A. M. Kenyon, Albert Kingsbury, E. J. Kunze, Mrs. Kunze, V. E. Laknosky, J. H. Leete, S. B. Linhart, S. B. McCormick, F. M. McCullough, F. F. McIntosh, W. T. Magruder, Anson Marston, E. R. Maurer, C. L. Mees, H. B. Meller, E. E. Mercer, Hugh Miller, J. T. Morris, G. H. Morse, J. L. Morse, W. E. Mott, J. H. Nelson, H. H. Norris, Frank Orbin, E. B. Paine, Earl Querbach, F. N. Raymond, N. C. Riggs, S. R. Rhodes, W. J. Risley, Ralph Rogers, A. B. Sage, H. E. Satterfield, J. A. Schaeffer, E. C. Schmidt, W. H. Schuerman, P. K. Slaymaker, H. E. Smith, J. H. Smith, L. B. Smith, F. P. Spalding, R. F. Stewart, H. H. Stoek, T. L. Sturges, jr., A. N. Talbot, Mrs. Talbot, J. M. Telleen, H. R. Thayer, G. L. Thomas, J. S. Thompson, J. C. Tracy, C. L. W. Trinks, F. E. Turneaure, M. E. Wadsworth, F. C. Wagner, R. J. Watson, J. B. Webb, John Weber, C. N. Wenrick, A. L. Westcott, J. M. White, W. O. Wiley, A. L. Williston, A. J. Wood, Mrs. Wood, W. R. Work, A. J. Wurts, C. M. Young.

## Minutes of the Council Meetings at Pittsburgh.

### *First Session, June 28.*

The meeting was called to order at 9:00 a. m. by President Talbot with the following members present: Crandall, Hibbard, Leete, Magruder, Maurer, Norris, Talbot, Turneaure and Wiley.

A list of 42 applicants was recommended to the Society for election. (This list is printed in the June and September Bulletins.)

It was voted to recommend to the Society the increase of the dues to $4.00 to permit the continuation of the Bulletin and the Secretary was instructed to make an announcement

to this effect to the Society preliminary to the executive session of the Society.

The Treasurer was authorized to expend a sum not to exceed $200 for the opening of a set of double-entry books, this sum to include the honorarium of the Treasurer's assistant for the year 1911–1912.

It was voted to recommend to the Society the continuation of the BULLETIN and its establishment as a permanent institution.

On motion of Professor Magruder it was voted to recommend to the Society the addition to line 4, article 6, of the by-laws the following: "except the volume of the *Proceedings* of the last convention, which shall be edited by the retiring secretary."

The Council received the report of the Program Committee to the effect that in the unanimous opinion of the Committee it is inexpedient to print the report of the Committee on Technical Books for Libraries, as it is practically impossible to do justice to the enormous number of technical books on the market.

*Second Session, June 29.*

President Talbot called the meeting to order at 9:00 a. m., with the following members present (the list includes members of the new Council): Messrs. Emory, Kent, Magruder, Norris, Talbot and Wood.

Letters were read from officials of Atlantic City, Niagara Falls, St. Louis, and Chicago, inviting the Society to meet at these respective cities next summer.

The Council voted to recommend to the incoming Council the city of Boston for the next meeting, provided that, for special reasons, some other city does not prove more suitable.

Resignations were accepted from Messrs. J. H. Barr and J. B. Stanwood.

On motion of Professor Magruder the standing committee on statistics was discharged and a new one ordered.

A letter from Dean A. H. Fuller concerning certain statistics of sizes of sections, duties of instructors, etc., was referred to the Committee on Statistics.

The Secretary was instructed to ascertain the status of the work of the Joint Committee on Engineering Education.

HENRY H. NORRIS,
*Secretary.*

# THE ENGINEERING TEACHER AND HIS PREPARATION.

## PRESIDENTIAL ADDRESS.

BY ARTHUR N. TALBOT,

Professor of Municipal and Sanitary Engineering, University of Illinois.

THE past year has been noteworthy in the history of the Society in two ways: first, in the wonderful increase in membership, 1,070 members being reported by the Secretary, the teachers of the membership representing more than 133 colleges and universities; and second, in the establishment of the Society's BULLETIN as a monthly means of communication. Various influences are responsible for these advances, but the chief among them is the activity, energy, and loyal effectiveness of the Secretary. The President here expresses his appreciation of the Secretary's most valuable services; and he congratulates the Society upon having so efficient an officer. He wishes also to felicitate the Society on its prosperity and its growing opportunities for service.

Of those who attended the section of Engineering Education of the World's Engineering Congress in Chicago in 1893, sixty-three joined in forming this society. The large membership just reported and the large number of institutions represented therein show in some measure the great expansion of engineering education in recent years. Not only in instructional staff, but in numbers of students, in buildings and laboratory equipment, in opportunities afforded, has there been expansion beyond any prediction of 1893.

In view of this great development, made with more than normal rapidity, may it not be worth while to inquire somewhat into the qualifications expected in the engineering teacher, to ask what the methods of preparation for his high responsibilities should be, and to find whether conditions indi-

cate that the future will see new methods of preparation and additional requirements?

It is axiomatic that a teacher should be a man of character, ability, and education. It goes without saying that he should be well versed in the subjects he teaches. Not only must he be able to impart knowledge, but he must know the principles of education, appreciate the aim of teaching, and use the methods which are necessary to attain results. Engineering experience and professional attainments also are generally considered essential. General culture, tactfulness, force, energy, balance and the various elements which go to make up a well-rounded man are usually thought of in counting up qualifications. How, then may the desired qualifications best be secured? How may the preparation and development best be attained? How may the selection of men and their advancement be made most effectively and satisfactorily? To what extent does natural aptitude overcome necessity for special preparation? Is the teacher born and not made, and to what extent has he like Topsy "just growed"? These are some of the questions which arise when a discussion of the qualifications and preparations of the engineering teacher is made.

It will be seen that the qualifications for the engineering teacher are even more severe than those expected in the general teacher. In addition to character and general education and scholarly attainments and knowledge of man and human nature and of pedagogical methods and principles, he is expected to have a broad training in engineering science, to have some considerable knowledge of engineering art, and to have had experience in the professional and business side of his work.

It will be admitted that the great teachers have had the power to impart knowledge and to impress their personality on their pupils, and that natural gifts may enter largely into the success of the teacher. But further than this we can not well go. Mere teaching aptitude is insufficient—the "born" teacher may not be a well-rounded and efficient teacher. I well remember doing service on railway location in mountain-

ous country under a "born" locating engineer who could almost by intuition place the line in its predestined place. He could direct the party to back up so far, run in 245 feet of 15° curve to the right, and then blank feet of tangent. True, the line generally fell where he planned it should go, and the cuts and fills were as he expected them to be, but as I look back upon it now I conclude that I was right in thinking that he overlooked some of the fundamental principles of railroad location as known at that day and that the railroad company would have profited by having the location made by a man better versed in the science and economics of engineering and of railroading. Since that time the science and the art of engineering have had a wonderful development, and the methods and standards have changed until the "born" engineer has become a rarity. And I am not sure but if we looked into the history of the "born teachers" we should find a period of preparation, a time of growth, of opportunities for training, which would go far to explain the success of their teaching.

In discussing preparation for engineering teaching, mention may be made of undergraduate and graduate study, experience in engineering work and in business, pedagogical training and instruction, experience in the work of assistant or instructor, general cultural education and development, research work, etc. Granted that a man has had a strong undergraduate course and has shown marked ability as a student, what should his further preparation be?

A qualification in an instructor, commonly considered desirable by administrators of engineering schools, and looked upon somewhat askance by those connected with other departments, is that he shall have had experience in engineering work, and this whether the work directly applies to his subject or not. The qualifications set out for a teacher imply growth, maturity, breadth of view, knowledge of conduct of engineering work and of the world of affairs, as well as technical knowledge of engineering science. The old-time teacher has been characterized as narrow, unpractical, unbusiness-like, inexperienced in affairs, unable to take the point of view of

the business world—and possibly in some lines of education this charge was sometimes not without foundation. It seems certain that even a short experience in engineering work will be of considerable advantage in more ways than one to a young man beginning his teaching career. It will give him confidence. It will help to give him standing. His judgment of essentials and non-essentials will be better. Distance from undergraduate days will have improved his perspective in many ways. Some facility in turning off routine work will have been attained. His knowledge of life will have been added to. Doubtless in many cases this additional experience will be worth more than time spent in advanced study. And as a prerequisite to teaching certain technical subjects it seems quite essential that the instructor shall have had adequate professional experience in design and construction of engineering works of similar character. The professional training thereby attained and the acquaintance with men and methods, will also add greatly to the teacher's equipment.

But what of advanced study, of graduate work, of investigational effort? To what extent is this essential? To have taken graduate work has long been considered a recommendation for the engineering teacher. Have we come to the stage of development in engineering schools when graduate work shall be included among the essential qualifications? What should this graduate work be, and how much should be required? In some universities requirements are in force in the departments of science and in other lines that a man must have the degree of Ph.D. before he may be appointed even to the rank of instructor. Surely we shall not reach this point in engineering schools in many years, but the practise referred to shows the emphasis now placed on graduate work as a preparation for the teacher in other lines. However far we may equate engineering experience for graduate work in making up our estimate of the qualifications for the engineering teacher, we must not overlook the advantages which come from graduate work. Aside from the general development given by study, graduate work if properly carried on not only

broadens the view and extends the range of knowledge, but it deepens the hold on basic engineering science. It gives an insight into the foundational parts of the subject. It develops independence and fosters originality. It takes the student away from dogmatic or conventional acceptance of views possible in undergraduate days. His analysis takes new life and his study of the work of the master investigators correlates laboratory work and analytical research in such a way as to give meaning to engineering science and its foundations. The knowledge which comes with this work is subsidiary in importance. To the man who plans to make teaching a life work, two or three years of systematic graduate study in engineering science and related lines will give a foundation which will enable the teacher in succeeding years more rapidly and more effectively to develop his powers and increase his opportunities for service. To the man who leaves teaching to go into engineering practice the development and training found in the graduate work is not less valuable. Whether the graduate study brings a degree is of minor importance; the need for thoroughness and system is plain, and the degree from an institution of standing is an evidence of accomplishment.

The number of students taking graduate courses in engineering science has been increasing in recent years. There is a growing recognition of the value of graduate work as preparation for the work of teaching. To my mind a great service may be done by the larger and better equipped engineering schools by outlining and giving courses of graduate work arranged especially for the prospective teacher and in promoting and emphasizing advanced courses for engineering teachers. Some institutions may be well fitted to give such work in certain branches of engineering science, while the strength of others will lie in other directions. In outlining graduate work, the needs of the teacher should be considered. Courses in pedagogy or in the principles of education and psychology will be found to be of great value. So many courses in nontechnical subjects will suggest themselves that it will be difficult to restrict selection to their proper proportion. So at-

tractive is the field of graduate work and so full of advantage to the teacher that this phase of engineering education must be expected to have a large development in the future.

It must not be inferred from what has been said that the training of the teacher includes only that which may be obtained from study and from experience on engineering work. Teaching is an art, and the experienced teacher has learned the art through years of work, acquiring it in a variety of ways. Just what form of apprenticeship may be best for the young teacher will depend upon the circumstances. An assistantship during the period of graduate study or a term of service as an instructor under the immediate supervision of a skilled teacher should be very helpful. In our larger engineering schools frequent meetings are held in which the instructional force, by departments or groups, discuss the subject matter taught, the methods of teaching, the makeup and quality of students, and the general direction and supervision given in various ways are all very helpful to young and old alike. The discussions of methods and standards and educational principles with other teachers, the contact with student and with faculty give opportunities for growth. Participation in administrative affairs and contact with the business side of the work, which exist in a well organized school, will help in developing another side. The wideawake teacher will take advantage of his many opportunities in developing himself in the art of teaching, and the degree of his success as a teacher should be recognized and will be measured by student and school alike.

But the question arises, is care exercised in selecting engineering teachers and in retaining and promoting them? Are men set at important teaching tasks without experience and without knowledge of their problem? Is there insufficient or ineffective direction or supervision of teaching work? An address given before the students of an engineering school by a prominent engineer who for years held a position as head of a department in a leading engineering school, recently published in an engineering journal, contains a severe arraign-

ment of teachers and teaching in engineering schools. Humbuggery, inefficiency, unbusiness-like methods, lack of supervision and direction, poor choice of men, degeneration with years, neglect of work—these are some of the charges and some of the terms used in the address. Now these are serious charges. They warrant attention. They can not be answered with denial or mere sarcasm. It is not the time or place here to review them or discuss them, or to pass upon their importance, but it may not be out of place to venture the personal opinion, formed from an acquaintance with Mr. W. D. Taylor and with a knowledge of his ability and candor and character and high-mindedness, that it was his purpose, in couching the statements in such terms, to ensure bringing prominently before engineering teachers and college administrators certain weaknesses in college administration which he believes call for remedy. Surely he did not mean in his exaggeration to make an indictment of the great engineering school with which he was long connected or to charge that the conditions of engineering education generally are as faulty as his phraseology would imply. His address may well serve as a text for discussion among college administrators and teachers. The maintenance of quality and efficiency is as important in teachers and teaching as in business organizations, though it must not be overlooked that the standards and methods are in many respects not comparable. The difficulties of finding the right men for positions and of learning the fitness of applicants is appreciated by those in administrative positions. Better ways of finding men and of determining fitness may yet be found, for the problem is of the highest importance.

The position of the engineering teacher differs from that of most teachers, not only because an experience in engineering work is considered a desirable element in his preparation, but in that the practice of the profession in some form and amount in connection with his teaching is thought by many to be advantageous to professor, student, and school. The thought is that connection with professional engineering work

gives valuable technical information, keeps the teacher in touch with his subject, vitalizes his work, interests the student, and advances the standing of professor and school. Doubtless in many specialized subjects an arrangement may well be made by which a practicing engineer of standing may give part of his time to teaching a professional subject. Doubtless many a teacher has profited greatly through carrying on an engineering practice along with his teaching. Doubtless, too, public interests may be served through coöperation with engineering teachers. Evidently also teaching may be enlivened through references to actual engineering operations. But may not participation in engineering work be carried on in such a way as to detract from the results which may properly be expected from the teacher? If a man, for any length of time, does full teaching work, and gives as much or more time and energy to outside professional work, which work suffers? If a prominent engineering teacher, head of a department in a great university to which students are drawn by virtue of his reputation and prestige, and who is advertised to give and direct instructional work, devotes three-fourths of his time and nine-tenths of his energy to engineering practice, is it to be expected that the students of this institution will profit much by his connection with it or that the department will show vigor and energy? And when the participation in engineering work degenerates into mere necessity for filling out a meager salary, or even for extending the annual savings, without reference to the value of the work in the development or advancement of his usefulness as a teacher, the practice is indefensible. Surely there is great chance for the abuse of opportunity. Surely there is need for caution. In the first place every educational institution should be put on such a basis that the instructor will not need to depend upon outside work to meet the year's necessary expenditures. Omitting the case of specialized instruction and of special provision for part time engagement, and agreeing to the advantage of keeping in touch with the professional activities in his specialty,

may we not with prudence say that the limit of outside work should be placed below any amount which will interfere with efficient instruction, adequate attention to the needs of students, and the requisite energy and zeal and ambition for the teacher's work, and that in its nature the work should be limited to that which will extend the experience and training of the teacher, or make an addition to professional knowledge, or be of special service to the community or the public in some way not possible by the outside engineer. And especial care should be taken that administrative duties and the direction or supervision of instruction be not interfered with by outside interests. Beyond these limits, participation in engineering activities may well be relegated to vacation periods and leaves of absence. When these limits are transgressed, it may be questioned whether the advantages of great names and high authorities compensate for loss of efficiency and vigor in instruction and of activity in the organization. The conditions of special cases where teachers are successfully carrying on important engineering operations without interfering with the conduct of their teaching, are so apparent as not to modify the applicability of these principles to general cases. It is worth while, too, to consider other methods of inspection and study of engineering work, opportunities which with the courtesies always afforded the teacher may in the same space of time give several times the knowledge and general development to be obtained by connection with a single piece of work.

The engineering teacher may be expected to have developed qualities and experience which will be serviceable in the practice of engineering should necessity or choice take him into practical work, and his teaching experience will be found valuable. But what of the practicing engineer, trained and skilled on the practical side of the work? Will he make a successful teacher, is a question which is often asked. He has the development gained from a business experience; he has met the problems of administration; he has matured in mind and in judgment, he has grown in technical knowledge; he

has become learned in human nature. To what extent do these offset his remoteness from the student stage of development, his habits in routine work, and his respect for detail and completeness. Numerous examples are at hand where practicing engineers have become successful teachers, but it may be expected that unless they are caught young there is more than ordinary risk in the trial. Possibly two exceptions may be named—the instructor in highly specialized professional subjects, and the man of administrative experience who takes up duties which are largely administrative.

In this discussion, the teaching function of the engineering school has been in mind, and the well-being of the student has been the prime consideration. The two other functions of higher institutions of learning, research and public usefulness, are not within the scope of this address, although it may not be out of place to refer to the indebtedness of the engineering profession to engineering schools and engineering professors for their important contributions to engineering science and to express the belief that in coming years the contributions in investigation and research will be larger and more important.

The topic of this address may seem trite to you—the opinions advanced may not be agreed to—but the theme is a live one, and the advancement of engineering education depends upon the quality and efficiency of those to whom this great work is entrusted. Teaching is a high and honorable calling. The inspiring teacher helps to mould the youth and affects his life in ways that are far-reaching. The indirect effect on the world's activities and standards are no less marked. With the continued development of the vast resources of our country engineering activities and operations have come to take a leading place. Engineering education is called upon for greater efforts. There is need for more efficient work, for better comprehension of the problems, for higher standards of work. Great as have been the accomplishments of the past, improvement should be the watchword of the future. Shall we not work together to raise the standards of the teaching profession

higher and ever higher? And may we not expect the Society for the Promotion of Engineering Education to be a potent agency in advancing the art of teaching and in establishing standards of accomplishment toward which the engineering teacher of the future may well strive?

# ENGLISH IN THE ENGINEERING SCHOOL AT TUFTS COLLEGE.

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The papers of Professors Telleen and Kent and of Deans Anthony and Clark, read at the last three annual meetings of the Society for the Promotion of Engineering Education, are evidence not only that engineers recognize the importance of ability to use one's native language effectively, but that they are giving more and more thought to methods of instruction in English. For this reason a few somewhat radical experiments which the English department at Tufts College has tried will, I believe, prove of interest to the members of the Society.

We have departed from common practice mainly in three ways; in shaping the work in English more frankly and more completely for engineers; in giving systematic training in technical writing; and in adopting special means of increasing the efficiency of the work. I shall attempt to suggest something of what we are doing under each of these heads.

## I. English for Engineers.

The attitude toward the subject of English is different in different engineering schools. In some colleges the students in engineering are sent to the academic department for all their instruction in English; in others they have their separate English teachers, yet are given purely academic training. Even in those cases where the work is specially adapted to the engineering course, there are wide differences in the interpretation of what should be sought by such adaptation. Some instructors consider that it is enough if they condescend to the limitations and in part to the special interests of engineers in

order that they may bring this work in English as nearly as possible into line with traditional college teaching. To them any radical change in method or purpose is repugnant because they consider English as the last bit of salvage from the arts course remaining in the engineering school and as the only means of true culture in a curriculum otherwise hopelessly practical. Other instructors would limit the work to what might be called a course in business English, on the ground that engineers have neither time nor need for broader training. At Tufts, the Engineering School is regarded "as an institution for educational development, and not solely as a training school for one or more classes of professional men. Our aim is to provide the best education for that class of young men who may better secure their collegiate training through channels which carry a greater degree of technical work than do the schools of letters."* Of this educational development, English forms an organic part; like the other subjects in our course it aims to give broad, collegiate training; and, like them also, it strives to attain its object through the technical training of engineers.

Our freshman English begins with a lecture on the engineer of the twentieth century, and according to the demands of that ideal we shape all our requirements. This is not a preliminary promise to catch the interest of the students; we are frankly committed to the principles that we should set no task which we are not prepared to justify even to those who "want only engineering subjects," and that the attitude we ourselves should always maintain toward the work is that of the engineer. This does not free the subject from limitations. The students of engineering generally have not had previously and will not have in the course so much work in language or in literature as candidates in arts; their ability in such subjects may be less; and their interests turn in other directions. Yet a careful consideration of the needs of the profession leads to an elementary course as thorough, as broad, and as varied as that given students in arts; and, when the subjects are

* From the Report of the Dean for the Year 1909–10.

properly presented, engineers are apt to put into their work more original and earnest thought. Moreover we find, as I believe everyone will who studies the case without prejudice, that for those who have already entered upon what is to be their life work, true culture comes not from turning aside to other interests as higher, but from so conceiving their special work that it will be worthy of a life's devotion.

The more advanced (elective) subjects in composition are also shaped especially for engineers, the best illustration of which is the subject of argumentation. In colleges this subject has dealt mainly with formal forensics and debates. The training which this gives is valuable for anyone, but we do not offer it because the engineer will probably find no occasion to argue in such formal ways. He will have opportunity, in his engineering societies, to enter into discussions or even informal debates; and for that kind of speaking we try to give practical training. On many occasions where there is no discussion, the engineer needs to be able to present subjects convincingly; and we pay even more attention to preparing our students for handling technical subjects so as to win a favorable judgment. Above all, the engineer needs to be able to carry on investigations not so much in order to convince others as to form a just opinion himself; and to that end we shape the main part of the work. In turning from the study of formal forensic writing to more practical argumentation and in putting the main emphasis on the formation and expression of just and unprejudiced opinion, we are adapting the subject to the needs of the engineer, but instead of lessening the value of the training, we believe we are doing exactly what should be done in any undergraduate course.

The contract under which we work at Tufts requires us to train engineers, but not simply engineers who are hired men. The graduate should be able to work with others and over others. He needs to know something of life and its problems; consequently he is required to study economics, and for the same reason he will profit by the study of the literature of the past. But even the various subjects in literature must

be shaped entirely for engineers, if we undertake to live strictly up to our principles. Not that we attempt to treat the subjects in a "popular" way; too often that means the degeneration of instruction into entertainment. We simply bring each subject as a whole and in all its details into real relations with the work of the engineer. This might seem to put a deadening limitation on the instructor. On the contrary, we have found that it is a strong incentive to the best work, for it means that the teacher must come out of the closet of his own special research and so present the subject that it becomes attractive and of definite value to young men of different and seemingly opposing interests. Many of the technicalities with which the special students of literature are concerned must be left out, it is true, for the engineer simply needs to learn how to use a library as a means of mastering new subjects and to gain a clear idea of the value and the interest which the past has stored up for him. But of the important matters of history and literature, few if any are without value to the engineer, for the only rational ground we have for calling them important is that they have been instrumental in bringing about present conditions and so shed light on live problems of the present. Here again we are shaping the work for engineers, but we believe that to humanize the subject is an advantage to any general student.

## II. Training in Technical Writing.

Everyone who has any real knowledge of engineering literature knows that it is a form which it is difficult to write effectively. "Contrary to the popular notion, the creation of so-called 'atmospheric' impression in literature is much easier, and of a lower order of intellect, than to convey in familiar words exactly what was done and why. This also takes imagination."* And when the task is not one of recording merely, but of constructive creation, as in writing a long technical report, magazine article, or book, great skill is required to

* Charles D. Stewart, in the *Atlantic Monthly* for October, 1908.

give really adequate treatment. Yet it has been commonly assumed that for such writing a course in general composition is enough. No lawyer, minister, dramatist, novelist, or poet would assume that because he had had general training in composition he could become a master of his peculiar form without special study. Certainly the engineer, using a form of discourse which, unlike the others, has not been carefully studied, and reading technical literature much of which is by no means effectively written, has no less need for special instruction. Clearly the engineering schools should give him the instruction and the practice he needs, not merely in literary exposition (from which he will get little help in his special difficulties), but in writing on technical subjects.

Many seem to think that if a piece of technical writing is not satisfactorily done, all it needs is to have a few commas added, a sentence tinkered here and there, and certain words replaced by more elegant expressions. This is seldom enough. If the defects are at all serious they go to the very foundations. The subject needs from the start to be thought out accurately and completely, and to be expressed in such logical form that the special readers addressed will get just what they need to know with no waste of effort because of shortcomings of the writer. For these reasons we give an elementary course in the principles of technical exposition in which a few typical subjects are studied minutely in order to make clear the chief fundamental problems of engineering writing and to give the students a thorough logical drill. In addition to this we give an advanced course in the writing of theses on research or construction work which the individual students have done.

This special drill in technical writing is not intended to take the place of other work in English; rather it is additional —the final bringing of the training in composition into relation with the special problems of the profession. The extra time required would lead some to prefer to leave the student to work out his problems blindly by himself; but the work may be justified as valuable general training. In the old-

fashioned college course, the years of training in exact expression required by the study of Latin gave the students thorough drill in exact thinking. The engineer seldom has the advantage of such discipline, and the natural results show in the loose thought and still looser expression of the majority of technical graduates. For the needed mental discipline a course in technical writing offers one of the best opportunities.

Many believe that it is the business of the English instructor simply to teach the use of correct English, not to give mental discipline which will help the student to think. There is discipline enough, they say, in the technical subjects in engineering. But work in applied science is defective as general discipline at the very points where a course in technical writing has its best opportunities. Let me explain briefly four of the most important of these opportunities.

In the first place, much of the thinking in applied science is done by means of visual images and symbols, and not in words. But thought and language are so nearly inseparable that, at least in the case of the ordinary undergraduate, when the thought has not been carried to actual expression in words there is always ground for questioning the accuracy or the completeness of the thought. In most cases when we hear it said, "I know but I cannot express myself," we find, if we make investigation, that the student does not quite know. And we generally find that, if he is led to attempt to put his ideas into exact language, he will either arrive at full knowledge or will at least get an exact idea of what it is he does not know, which is the first and most important step.

In the second place, a large part of the thinking done in the science courses is carried on with the objects themselves at hand and generally in actual use. But in some of the most important parts of engineering work, such as designing, inventing, planning, and organizing, the thinking has to be carried on with the objects present only as ideas. And reasoning without the objects present to suggest, guide, and correct, thought is much the more difficult. We frequently get students who insist, for example, after having used transits for

a year or two, and used them satisfactorily, that the verniers are on the same plate as the graduated circle. So much more thorough mastery comes through working out a complete explanation of an instrument or of a process without the objects present—as is required in the English class—that we find most of the students ready to spend the time required to write up the subject, as soon as they have grasped the method, for the sake of what they learn about the instrument or the process.

In the third place, the English class gives an opportunity to train students in expressing themselves effectively to different sorts of minds. In their other subjects, whatever they undertake to explain is addressed to the instructor, that is to say, to one who knows more than they about the subject and who, in all probability, is mainly interested in discovering a hint here or there which will enable him to determine how much the student has got from the special instruction given him. Writing of this sort is quite different from explanation which is in itself clear and complete; and passing back ideas to the one from whom they were received is much simpler than explaining one's self to different grades of knowledge and of interest. Much of the writing done in the subjects in applied science is of a nature to incapacitate the student for explaining his ideas as he should in an engineering report, to say nothing of making a technical subject clear to a non-technical reader.

In the last place, the English class gives opportunity to train men in thinking and expressing themselves completely and accurately. For this, at least, it might well seem there should be no need, for is it not the essential purpose of all the work in the engineering school to train students to think? But in science courses subjects are not treated completely; many are taken up part here and part there in various connections. It is the business of science to proceed step by step along an endless path. Literature on the other hand, being an art, insists on bringing things into unity. Now a certain amount of rounding up ideas into relatively complete wholes

is most valuable in gathering together loose ends, in bringing out relationships, and in fixing facts in the memory. As for accuracy, if the science instructors always insist on results, that is about as much as can be expected. Attention can seldom be given to the way in which the student thinks out his results. With large classes and the consequent small amount of attention given the individual student, and with the increasing amount of work to be done and the consequent haste, it often happens, in spite of all the instructors can do, that students in the elementary subjects are not only permitted to continue slack habits of thinking but are actually led to develop such habits, so that much effort is required later to unlearn these lessons. In the English class we take up a few subjects, not more than a half dozen a term, and study them so minutely as to give the students a realization of what accurate and complete treatment means.

Naturally the good results obtainable in such a course in technical writing would not be possible if the students were not at work at the same time in their science courses; but the English class gives opportunities to knit together many loose ends of training and to make special study of the possibilities of effective thought and expression in dealing with technical subjects. It lays the foundation for more efficient work in all the remainder of the engineering course and after graduation, such a foundation as every student in college should have, but which each should get by writing on those subjects of which he has special knowledge.

### III. Efficiency.

Much has been done during the past generation to make the teaching of English more efficient. It is now generally recognized that the object is to teach students to think and to express their own ideas effectively, rather than to require them to explain or to apply principles of rhetoric. The work has become more and more personal, that is to say, a study of the difficulties and the possibilities of the individual student

in conference, rather than theoretical class instruction. In the last place, the college methods of the recent past, which tended more and more to unfit a man for using spoken language, have been so changed that students are being taught to speak as well as to write. Not all schools have yet adopted these methods, but they are in general use, and if we have tried to accomplish all we could at Tufts by these means, we can claim nothing original. We have, however, sought efficiency in certain other ways which are not generally recognized. I shall speak of these under three heads: efficiency in the work of the student, efficiency in the work of the English instructors; and efficiency of the school through coöperation.

The efficiency of the ordinary student in English is under all circumstances difficult to maintain. He can already read, speak, and write his native language in a way that serves; and, no matter how hard he strives to improve, progress seems slow and uncertain. For years he has labored over English till he is tired of it, and the subjects he is generally asked to write on are not in themselves interesting enough to carry him through the wearisome process of composition. The secondary schools more frequently discourage the student over their shortcomings than instill into them interest and ambition. The instructor can do much through sympathy and personal knowledge of the students; but in addition he needs to consider two facts. In the first place, no one can write to advantage on a subject about which he knows little, and the untrained certainly cannot do themselves justice on subjects in which they are not interested. In the second place, the knowledge that the writing is to serve no real purpose is enough to wilt the nascent determination of any but those who have natural talent for writing. In spite of these facts, teachers ask students to write mainly on subjects about which they can have no real knowledge and in which they are not at all interested, and frankly consign the papers to the waste-basket after they have been graded. Obviously if we would increase the efficiency of the work we must cease to require students to do what we should revolt at doing ourselves.

Great care needs to be exercised in choosing subjects about which the students have some real knowledge; and by giving thought to the matter many may be found which have real use. The mathematics department, for example, wants a concise explanation of the process of interpolation to be used in class instruction; or the drawing department would like to have the students carefully write up the method of plotting a curve. The college newspaper wishes news reports of all sorts and thoughtful suggestions on any subject of college interest. Many good suggestions as to class methods, fraternity life, the athletic situation, and similar subjects will come from the undergraduates, and if the instructor talks each suggestion over with its author and explains other views of the subject, he often can interest the student to write a strong defense of a good proposition. We have often sent to the Dean, to the President, or to the Trustees a freshman suggestion which has helped to effect an important reform. Then, too, the college literary paper is always on the lookout for good stories and critical articles. It is surprising how much interest freshmen engineers will take in writing stories, and how much they will gain from such writing. Some forms of writing which we wish to require we cannot put to such immediate use; but we can often make the subject interesting to the student. At the time we call for a character sketch, we invite an engineer who has had much experience in handling and in estimating men, for example, a manager of a branch of a great electric company, to speak to the class on character in engineering and how to judge men. When we wish a reminiscence written, we call in, let us say, a member of the faculty who has made some notable explorations, and have him tell stories of his work. As a result most of the students no longer write simply "themes." In spite of all we can do, there is some writing without interest or purpose, but we watch for it and in conference we can in part overcome the difficulty, so that we may hope in all cases to make writing wait upon knowledge, interest, and recognition of real purpose.

The efficiency of the instructors is much more easily devel-

oped; and it is surprising that so little is done in many colleges and schools to fit the teachers for the work they are to perform. Attention enough may be paid to seeing that they "know their subject," but except in advanced work that is by no means all of the real need. At Tufts we require each new instructor in English to serve a year's apprenticeship. During that time he has papers to read and conferences to hold, but no charge of classes. Moreover, he is required to attend all the classes in English as listener and critic. To many this would seem needless waste, but we have not found it so. The real waste is to let a man blunder into his teaching without exact knowledge of his predecessor's experience. The new instructors we engage are without experience as teachers, and by attending classes they not only have the needed opportunity to learn what past experience has taught as to methods, but are able to suggest many improvements. Since they are generally nearer the students in years, position, and interests, they can observe the actual working of the system, the real success and the many points of failure, much more accurately than the teacher in charge. Such apprenticeship requires the teacher to do much himself that is usually turned over to assistants, but the gain in insight and in suggestions more than pays.

We also require all our instructors to spend as much of their time as possible with the instructors of other departments that they may be in actual contact with engineering work, that they may know exactly what their students are doing in other classes, and that they may have the opportunity of looking on their own subject from other points of view. We allow them time and encourage them to study, to write themselves, and to assist fellow instructors and others who may be writing, in order that they may overcome the warping influence of dealing entirely with immature minds. In the last place we keep the whole department in contact with English as it is used in the engineering world beyond the college limits by calling in well-known and successful engineers to speak on various practical problems of writing. It is difficult

to get speakers who are satisfactory, because many are unwilling to express their views on the use of English before a teacher of the subject, and because many are unable to grasp the freshman position; but all teachers need some such check on their work. One who studies the art of composition from the teacher's side of the desk only is certain to give undue prominence to his personal hobbies and is in constant danger of losing contact with real life. The practical man may come to have unworthy ideals in writing, but after all it is he that puts the training to real proof.

Our situation makes it possible to bring about helpful coöperation among the members of the faculty, which increases the efficiency of the school as a whole. The English conferences with the freshmen are held while the men are in the drafting rooms or in the shops, so that at least one English instructor is present while most of that work is carried on. This helps the students to think of English as a part of their technical training rather than as something which takes them away from engineering buildings. In addition it makes possible continual coöperation between departments. For instance, the English instructor, in talking over a character sketch in which the student has given simply the external appearance, is trying to lead the writer to see for himself other possibilities. The student does not catch the idea, when the instructor in drawing, who has overheard a part of the conference, asks, "How about the dotted lines?" and the student sees at once. Or, circumstances may be reversed. The teacher of drawing, in explaining something to his class, has occasion to pass from the consideration of graphic language to some point of verbal expression, and he immediately calls upon the English instructor for his opinion. Instructors in English in engineering schools should be trained engineers, and teachers of applied science certainly ought to be masters of good English, but the ideal is seldom fully realized. As a substitute, coöperation is a great help.

The general possibilities of coöperation between the English department and the other departments in the engineering

school are numerous and very important. More than that, they are much more easily put into practical operation than those who have not made the attempt realize. I have already mentioned occasions on which the English instructor can get his class to write on subjects of value to other instructors; and there are many opportunities for such work during the four years. Then it is possible to bring into the English office much that is written for other classes, such as examination papers, reports, and theses; and conferences may be held with the students on these papers. To give students a few hours per week of artificial drill in the use of language in his "English" class, and neglect the real practice in speaking and in writing which they get all the rest of the time is certainly poor economy. We find it possible to have some influence over the language opportunities in everyone of the freshman classes and over enough of the sophomore classes to have a real check upon the students' work. In the upper classes the work we can do with the students is voluntary on their part, but with proper habits formed during the first two years a large number continue to look to the English department for help. In all coöperation with other departments it is of the first importance that the two instructors concerned work together over enough of the papers to bring them into understanding and agreement; otherwise there is almost certain to be serious friction. From his associate, the English instructor gets helpful insight into matters of an engineering nature and the opportunity to see his own work through the eyes of a mature person who is not a professional teacher of English. On the other hand, the instructor in the other subject not only keeps in contact with good practice in writing, but often gets help in presenting his own subject from working with one who is more mature than the students and yet may have even less knowledge of the special subject.

The position of English in the curriculum is different from that of any other subject, for the reason that no teacher in the institution can help exerting influence, good or bad, over the students' use of their native tongue. The training the

student gets depends not on the teacher of English alone, but on the general attitude of the faculty toward the subject. This is specially true in a professional school. If any teacher in speaking or in writing shows himself ignorant or careless, if he cannot use standard English, if he cannot express himself without confusing those he is addressing, he is exerting harmful influence. Even an instructor who is careful himself, if he permits his students to use wretched English without protest or with the simple comment that he has no time to spend over poor English, is giving the suggestion that correctness of form and clearness of expression are of entirely secondary importance in practical work. Since this suggestion is naturally welcome to those students who are having difficulties in writing, it will in many cases be more powerful than anything the instructor in English can give in the few hours he may work with his class. On the other hand, if the instructor insists that accurate thought and clear expression are essential parts of all the student's work, he is teaching English whatever his department may be; in fact his influence is greater if he is not a professional teacher of English. Many teachers of science think they have no time to devote to form of expression, or they feel they have not the technical training necessary to deal with language questions; but the teaching of adequate expression within his special field is an essential part of every instructor's business, and whether he recognizes it or not no teacher can escape training his students in the use of language. It is not a question of thorough mastery of "good use," for many of the technicalities of the rhetorician are of little real importance; it is not a question of always being right—many good teachers of English are far from models themselves. The important thing is to realize that the writer should always express himself accurately, completely, and in such form that the reader gets his meaning without unnecessary effort, and that the writer should avoid such language as will distract the reader's attention from the subject matter and center it on the writer's ignorance or carelessness. By proper methods of coöperation we believe it is

possible to make the whole school a unit in teaching good English.

## Results.

At Tufts we have been working under specially favorable circumstances. Members of the Faculty have been ready to spend much time reading papers with us and assisting with suggestions, and above all, we have had the advice and criticism of a President and of a Dean who are not so much specialists in engineering as expert educators. Yet we have had difficulties to overcome. Many of our methods have been, as far as we know, innovations, consequently we have had to cut and try without the guidance of previous experience; we have had to discover and train our instructors; and we have even had to write all our text-books. The success of our methods we cannot judge, but we believe that where they have not worked well the failure has been due to defects in the human instrumentalities. It is our ideal to keep our work strictly training for engineers, to meet every practical need as fully as possible, to help in giving the students the broadest interpretation of the profession, and to take advantage of all the opportunities for training which the curriculum offers and of the conscious and unconscious assistance of all the instructors. We believe that the results of our work, both in composition and in literature, will compare favorably for thoroughness and breadth with those attained in any general collegiate course, and that we have but applied to "English for students of engineering" methods which would increase the efficiency of the teaching of English in any school.

# THE PREPARATION OF WRITTEN PAPERS IN SCHOOLS OF ENGINEERING.

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Professor Earle has described the work of the "English" instructor and explained somewhat of the motives and conditions which govern that work as it is now conducted in some, at least, of the schools of engineering. In this paper, therefore, I shall omit much of what I had thought of saying about that, except to reënforce, if possible, some of his statements and to use some of them as a starting point for my own. Especially I wish to call attention to Dean Anthony's remark* that he believes the method of conducting the English work there described is the proper method, not only for the school of engineering, but for the other schools as well; the school of medicine, the school of law, the college of liberal arts.

I wish to present to the Society some considerations which may form a basis for the practical discussion of the whole matter of using written papers and books to best advantage in the engineering-school work. The statement is necessarily much condensed; I hope it will be suggestive. This society has often considered subjects which are really phases of this large one, and has shown that the efficiency of this kind of work is of interest, directly, to all departments of the educational system and to the men who have to use the services of our graduates. The discussion to be brought out will secure, it is hoped, some clearer understanding of the character of the training that is to be given and a greater degree of common effort, by all who have anything to do with it, to secure the best possible results.

Let me review some commonplaces. The writing of papers

* This remark was made by Dean G. C. Anthony in connection with the abstract of Professor Earle's paper which he presented.

and the study of books are to be regarded, in themselves, as one kind of work. For want of a better name this is often called "English," and its formal study put into a special department. But it is used in all departments, both as a means of education in itself and as a vehicle in the use of other studies for the purposes of education.

The best basis for organizing the study and practice of composition seems to be that of purpose. Methods which are too formal, in teaching, are dangerous, because the material to be worked in is the student's mind, and this is not to be shaped arbitrarily by pattern but developed in its own characteristics and its ability to work. At the same time some elements of uniformity have to be secured, because the very nature of scholarship is coöperative.

The great practical aim of a course of training, then, it may be said, is that the student be enabled to write independently next year; that is, that he be able to give other men information which will be useful to them and in such shape that they can use it.

The young man entering the field of scholarship has to learn what this service means. He has usually to learn the difference between committing to memory and reciting lessons of fact and precept which his teacher sets for him, and that kind of study which begins with gathering knowledge by his own observation and proceeding to reason upon it, with no answer in the book, but with the view to forming results which are the best humanly possible. This is education for service, indeed, but it is also the foundatiou for the development of genius (where genius exists), and the natural beginning of culture.

The practical difficulties a student encounters in approaching original studies are the unexpected complexity of real problems and his inability to use effectually what knowledge he has. He is in a new world intellectually, yet he has to learn to walk for himself. We can encourage him but we cannot, beyond a certain distance, teach him the way.

The immediate lessons, then, are those of accurate and

thorough observation, clear perception of purpose, and adaptation to purpose. These are, of course, the essential elements of all study; they belong conspicuously to rhetoric because the verbal statement is the direct embodiment of the thought. Along with these must be developed the spirit and habit of good workmanship. The language, for most men, is mainly the instrument of mental work, a few hundred words and a few rules of grammar and conventional forms of statement. These form a code of symbols by which men represent their knowledge and opinions; they are fairly easy to learn, when one pays attention, but the real problem of using them lies not in the forms themselves, but in the knowledge and opinion underneath.

The skill of language, however, from accurate spelling up, comes with the increase of knowledge and refinement of thinking and with the growing spirit of care in handiwork.

The actual manner of organizing such work is less important than are the recognition of its character and the coöperation of all departments to secure its effectiveness. The ideal method would be for each student to be so intimately associated with an all-wise teacher, no matter what the special subject of instruction, that his whole school work would be directed for his best intellectual development. This would involve a continuous preparation of reports and other papers of all kinds, and their best criticism. Somewhat of this is provided in particular schools and by particular teachers, but the great number of students and the extent of business in most schools makes it impossible. The inconspicuous student in his years of general preparation, at least, goes through the mill and comes out as he may. The dean is overworked, the drawing and language and mathematics give place to special studies; see, then, what an opportunity is open to the writing work, which is the only element to run through consistently with natural development during the whole four years—from freshman rhetoric to senior thesis!

The system, then, we will say, is to be formulated along lines that will be quite definite and yet pliable enough to fit

the service of all departments. It will have three main parts, the required work of the studies in "English," that is, the writing of papers and the study of books in the formal way; the required use of written papers and books in the study of other subjects; and the similar work which may be undertaken by the student for various reasons with such assistance as he can secure. This course is printed in succinct statement and each student and each instructor understands that it is to govern all the work of this character (except, of course, as changed for special reason in particular instances) throughout the four years. It is accompanied by a code of the standard forms of words, symbols, manuscript, and other parts, as far as it may be desirable to make these formal. If for any reason modifications or changes are desirable for special departments they may be prescribed by that department.

The special work of the "English" department, I believe, for the best results, consists of the freshman rhetoric and some kind of advanced composition with what provision may be for other help when the student may ask. Skill in writing is not to be taught to a great extent but grows gradually along with the increase of knowledge and the refinement of judgment. Spelling, grammar, and the other conventional forms of language expression are not to be taught finally. Year after year of observation have shown that just ninety per cent. of the students who come to us are weak in spelling and grammar, and in all cases that this weakness is grounded in poor eyesight and poor habits of workmanship. I do not believe in the "natural-born poor speller who is good at other work." Not one of the men under observation has failed to improve as he learns to use his eyes accurately and to hold himself responsible for greater attention in all kinds of handiwork.

The rhetoric course is therefore mainly introductory, to put the student into the right attitude toward his new work, to make him acquainted in a general way with the language used by his craft, and to teach him somewhat of mental

discipline.* It need not be a burdensome course, but should have weight enough to command its share of real attention among his many occupations; three hours per week for the year is probably enough.

The advanced course in a way follows the pattern of the former, but at a stage of the student's life when he has greater knowledge, more definite outlook, and more maturity of mind. It guides him as far as he is able to go into the meaning of men's work. It studies the nature of human knowledge, the means men have for acquiring knowledge, their natural methods of developing it and reasoning upon it and putting it to use. It points the way to the study of all subjects of human interest, even to the study of men.

Such a course need not be long nor require much time during progress, but it must be heavy enough to demand the most serious of mental effort. In our scheme it is given three hours per week for one-half year.

Scientific reports and other technical discussions form admirable means of studying methods of study. They are obviously purposeful and of the same character as the knowl-

* The practical work of the rhetoric class may be briefly indicated. The first exercise is always a statement of the student's name, place of residence both at home and at school, school experience, travel, and such other information as may be helpful to the instructor in laying out his work. This statement is obviously matter-of-fact and for real use. After being criticised and extended by oral discussion it is rewritten and becomes a permanent record. Next is assigned an explanation of the special work the student expects to do at school and a description of the equipment provided for this work; this statement is never satisfactory to the student, but it shows him somewhat of what is to be learned. Then he is asked for information about the town from which he has come to school; he offers first a gushing commentary, but upon questioning soon learns to give maps and specific facts, and discovers the gaps in his own previous knowledge of the most commonplace things. He is practiced upon sidewalks, broken fences, small pieces of machinery, with careful attention to dimensions, materials, etc.; and presently is sent to make descriptions, and later to make reasoned discussions which are needed in work which older students and instructors are doing. This practice, of course, lasts throughout the whole of a student's course at the school.

edge they represent. Accuracy and methodical progress are necessary on the surface of them. They are interesting, too, for both writer and reader, and easy means of arousing the schoolboy from his lesson-reciting to original study. Even the slow men seldom fail to find a new interest in their work when, after a few preliminary exercises, they discover the meaning of a request for an accurate matter-of-fact statement of information. To make this incentive more forceful, and also to do a real service in the conduct of other work, it is well to have these reports designed for actual use—that is, for contribution to a manuscript library in the rooms of the rhetoric department. Such a library containing description of places, condition, plants, methods of engineering work, etc., has been found to be remarkably useful.

The written papers required by other departments vary from brief records and reports of work done to the elaborate senior thesis. At Kansas a so-called "technical report" has been required of each student in each semester when he has no other special writing to do. This practice has lately been reorganized and become very profitable. The task is assigned for each student early in the term by some instructor in engineering, preferably upon some subject that is offered by the student; the paper is specified as 2,500 words in length and with certain characteristics; it is submitted in January or March, criticised, revised, and after acceptance is deposited in the library of the school. Each student ordinarily during his four years, puts into the the library four papers of this kind and his graduation thesis. He is not apt to resist the temptation to take pride in them. Incidentally, the sewer systems and power plants of the various towns in the State are pretty generally on record in our school library. Such written work as this, by its continuance through the whole four years and in its evidence of the interest shown by the professional men, is for many students the real force of the system.

If these studies have accomplished their full purpose the student is inspired with the wish to continue the same kind of

work. From what I have seen I do not believe in extending the formal rhetoric work beyond these two courses; I certainly have doubts of journalistic instruction for any but those peculiarly adapted to it. Studies in literature, history, economics, beyond those prescribed, are offered in the University, however; and the "English" department should be made the natural headquarters for those who have the liking to "spill ink" and to inquire into books. The "technical reports," which are to be judged by men in other fields of interest, furnish us a convenient means of laying out systematic studies and courses of library research. Men come to us for references and help in making bibliographies and card indices. They come to us to criticise their society and other public speeches, and their contributions to the newspapers. They come to us even to criticise their songs. The "English" department is not to be looked at as a sort of applier of varnish to hard-grained science, but as an editorial council for the promotion of whatever intellectual product there may be offered. And the "English" department ought to be large enough in spirit and in numbers to fulfill this duty.

Two topics, then, I wish to present especially for your discussion, besides the general subject of the character of training that may be done by the English department. The first is the possibility of compiling a code of authoritative forms, so far as it may be desirable to have such forms, to govern the use of special terms, abbreviations, capitalization, forms of manuscript, tables, bibliographies, illustrations, etc. The other is the organized coöperation throughout all departments to secure the best results in the matter of preparing written papers and work of similar nature.